Not less remarkable is the increase in the amount of the manufactures. In 1891 one building was sufficient to include a representative exhibit of the manufactures of the district; now it is difficult to compress such an exhibit into nineteen buildings. Trade returns confirm the impression which this comparison suggests.

An inquiry naturally suggests itself into the causes of this development. Recent years have certainly seen a great awakening of national life in Bohemia, but this alone would not be sufficient to account for the commercial prosperity of the country. A better explanation is to be found in the system of technical education which is being successfully worked in Bohemia. The scope and character of this system is admirably displayed in a well-arranged exhibit. Undoubtedly the keynote of the system is "specialisation," a word which has no terrors for the Bohemian, who is surprised that the exhibits from some of the special schools—such, for example, as that from a school for training barbers—should cause amusement to the English visitor; but, nevertheless, the fundamental principle of the system seems to be sound. A boy's trade is fixed, and whether or not he is apprenticed, he is trained definitely for the selected trade, without too much insistence on theoretical principles. If the boy is apprenticed he is obliged to attend an industrial continuation school during his apprenticeship. In these schools there are from six to ten hours of instruction per week, the lessons being given in the afternoons or early in the evening and on Sunday mornings. The course lasts from two to four years. If the boy is not apprenticed he is able to attend one of the special schools (*Fachschulen*) in which courses are provided, definitely taking the place of the apprenticeship. The industries included in the scope of these schools are lace-making, wood-carving, carpentry, cabinet-making, textile industries, basket-making, iron and steel work, engineering, masonry, glass-making, hardware goods, electro-engineering, locksmiths, musical instruments, jewellery, precious stone setting, machine embroidery, watch-making, and gun-making.

Another interesting type of school is the general handicraft school, to which boys of twelve are admitted. The aim is to give the boys a better preparatory training for a trade than is possible in the ordinary elementary school. Great stress is laid on drawing, and the boys are given practical instruction in the preparation of materials for wood and metal work. An experiment on these lines is at present being conducted by the London County Council. There are also higher industrial schools for well-prepared pupils who require a higher training for art, chemical or textile industries, building or engineering. In the larger centres of population there are central industrial institutes, where work of the nature of research is carried on.

The Austrian system of technical education is of special interest at the present time, because there is undoubtedly a tendency in England towards a higher degree of specialisation in the work of technical schools. It is being realised that an efficient system of technical education cannot be organised by the erection all over the country of technical institutes of the same type, with similar classes and laboratories, staffed by the same type of teacher. Some years ago it was discovered that mathematics could be taught for the practical purposes of engineers in a practical way, without much insistence on abstract principles, and since then a good deal of thought has been given to the special educational requirements of the several industries. Moreover, the educative value of the technical processes themselves is being more fully recognised. Mr. W. R. Lethaby, professor of design at the Royal College of Art, in a paper read to the International Drawing Congress on August 3, deprecated the "elaborate approaches to a practical subject" at present in vogue. "The great end," he said, "was production, the great thing was the trade, the craft, and sufficient culture could be hung up to any sufficient trade. . . . All proper education was the opening up of a necessary and beneficent life occupation." This expresses in the clearest way the principle which appears to underlie the Austrian system of technical education. The principle may be stigmatised as utilitarian; but anyone who doubts the practical success of the system will be well advised to examine the exhibits at the Prague Exhibition. T. Ll. H.

THE IMPROVEMENT OF AGRICULTURAL PLANTS.[1]

IN the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for May, M. Schribaux gives an account of the methods adopted for obtaining new varieties of agricultural plants. These methods fall into three groups:—(1) careful watch is kept for "sports," *i.e.* for plants which, for no obvious reason, differ from the others; (2) variation is induced by altering the conditions of growth; (3) suitable plants are "crossed."

The first method is necessarily haphazard, since sports can obviously not be predicted; it has, however, proved very useful in the past, and has yielded many valuable varieties of potatoes, of fruit trees, &c. The second method promises very interesting results, for some plants respond quickly to changes in their surroundings. M. Schribaux sowed in a garden soil the seeds of the wild carrot, an annual with a woody root. In two generations a certain number had become biennials, with a fleshy root like the cultivated carrot. M. Blaringhem adopted quite a different method with maize. Plants were cut down just as the ear was beginning to develop, *i.e.* at the time of maximum vital activity; 76 per cent. of those surviving developed abnormally. Some were permanently altered; thus a late Pennsylvania maize was converted into an early variety.

Another instance of great practical importance is furnished by the vine. After struggling long and vainly against Phylloxera, the French vine-growers have made up their minds to live with it. M. Viala visited America and brought back some vines which had become so differentiated from those growing in France that they withstood the attacks of the pest. Unfortunately, they would not grow on calcareous soils, but became very chlorotic, and further search was made. Vines were in the end discovered capable of withstanding Phylloxera and of growing on calcareous soils; these have solved the problem for the French grower. Perhaps the case of the sugar-beet is most interesting. The grower requires roots containing a large percentage of sugar, a low proportion of the accompanying salts, and capable of resisting adverse conditions. The selection is made, in the first instance, on the basis of the sugar content. A large number of roots can be rejected by simple inspection, for high sugar content is correlated with certain external features; the other roots are examined chemically, since it is found that removal of a portion for this purpose does not interfere with subsequent growth. The very best are then cut up into a number of pieces to be grafted into other roots; they produce seed, which is sown, and yields roots for further selection. M. Schribaux states that a single root has yielded sixty-four pieces, each capable of producing seed! It is not surprising that the percentage of sugar has gone up from 11 per cent. in 1870 to 16 per cent. or 18 per cent. to-day.

There is evidence, however, that the process will not go on indefinitely, for roots containing more than 18 per cent. of sugar cease to vegetate properly. Sir W. T. Thiselton-Dyer discusses this aspect of the question in the Journal of the Board of Agriculture for April, taking the potato as an illustration. Like the sugar-beet, the potato has been the subject of continual selection, and the end result is a highly artificial tuber of great commercial value but difficult of cultivation. The practical man speaks of degeneration, but Thiselton-Dyer does not consider this to be the case. He points out that the potato has been induced to load itself with starch far in excess of any natural requirement of the plant, and suggests that too much is being demanded of the plant, and the machinery for the processes of growth has reached its breaking point. "We can control nature in altering the constitution of a plant; but eventually a barrier is reached beyond which it is impossible to go."

It is often found difficult to fix the new varieties obtained by selection. Even when asexual reproduction is possible, as in the case of trees and potatoes, the variation frequently does not remain permanent, and many promising varieties have disappeared. When reproduction is by seed

[1] (1) *Bull. de la Société d'Encouragement pour l'Industrie nationale*, May, 1908.
(2) *Journal of the Board of Agriculture*. April, 1908.
(3) *Journal of Agriculture of South Australia*, January, 1908.

it is still more difficult to fix a variety; this is abundantly proved by the difficulty of improving wheat. A single ear is selected because it possesses some desirable property; the seed from it is sown; an ear is selected showing the same property, and the process is continued for several generations. "Pedigree" seed is thus obtained, but it rarely remains true; the farmer has to renew his stock periodically from the raiser, who keeps on the selection process. The work done on the selection of seed wheats at the Roseworthy Agricultural College is described in the Journal of Agriculture for South Australia; it is hoped in this way to obtain strains which will keep their character for two or three seasons, and prove much more profitable than the seed wheat now in use. There is no question that a good deal can be done by selection, especially in South Australia, where, we are told, little or no attention has been given to the matter, and the best grain is sometimes sold and the worst kept for seed. But it is now clear that the only safe method for the improvement of crops grown from seed is to breed on Mendelian lines, as Biffen is doing at Cambridge, and South Australia would do well to breed, as well as to select, seed wheat.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Robert Forsyth Scott, fellow and senior bursar, has been elected master of St. John's College in place of the late Rev. Dr. Charles Taylor.

PROF. D. J. HAMILTON, F.R.S., has, in consequence of ill-health, resigned the chair of pathology in the University of Aberdeen to which he was appointed in 1882.

MR. W. GALLOWAY DUNCAN, of Dundee, has been appointed head of the Government Engineering School, Dacca, Bengal.

THE Senate of the University of Bombay has, according to the Allahabad *Pioneer Mail*, decided to include a test in science for all candidates for a degree.

THE jubilee of the University Museum at Oxford will be celebrated on October 8. Honorary degrees will be conferred upon Prof. Arrhenius and Dr. Vernon Harcourt, F.R.S., and a bust will be unveiled of Prof. W. F. R. Weldon, who died in April, 1906.

THE Year-book of the Michigan College of Mines, 1907–8, shows that the college is better equipped and more prosperous than at any previous period since its foundation in 1885. There are now 253 students, their average age being 22½ years. The concentration of effort on training men for the field of mining, the situation of the college in the heart of the copper-mining region of Lake Superior, together with its special methods of instruction, have brought to the institution a large measure of success. Considerable range is allowed in selecting the courses or subjects which shall compose a particular student's curriculum, and the Record of Graduates, published as a separate pamphlet, giving their occupations, affords interesting evidence of the success attained.

IT is now recognised that the teaching of hygiene and physical exercises to pupils in both primary and secondary schools is of equal importance to their education in other branches of knowledge. In primary schools it is of special importance, as the opportunity for games is often absent in large towns. For this reason the Board of Education makes a knowledge of the methods of teaching and the aims of physical education one of the necessary parts of the equipment of a primary-school teacher. With this qualification is associated the requirement of a knowledge of hygiene, particularly in relation to schools and school children. For the last ten years a systematic course for women has been carried on at the South-Western Polytechnic, Chelsea. This training has been so successful that the course, originally designed for two years, has developed now into one of three years. The governors of the Chelsea Polytechnic are now instituting a similar course for men, and for this purpose they have engaged a teacher of gymnastics on Ling's Swedish system. In the first instance a course of one year for men will be provided, and it is hoped to obtain students who have passed already two years in training colleges, as well as university graduates with an initial equipment of general and elementary scientific knowledge. Such students, after a year devoted mainly to the study of hygiene, physiology, gymnastic exercises, and the part of anatomy bearing on physical training with study of the theory of movements, should be in a position to take charge of physical education in schools and to take their proper positions as teachers of usual subjects.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 5.—"On the Nature of the Streamers in the Electric Spark." By Dr. S. R. **Milner**. Communicated by Prof. W. M. Hicks, F.R.S.

(1) The streamers in the inductive spark consist of metallic vapour, the atoms of which are charged, and the motion of the vapour towards the centre of the spark gap is mainly due to the action of the electric force of the spark on the charged atoms. The chief evidence in support of this consists in a number of photographs in which the streamers move back again towards the poles as the oscillating electric field of the spark reverses its direction.

(2) Very great differences were found in the appearances of the streamers which correspond to the different lines of the same metal. The streamers may be divided in this respect into three classes, between which there is in most sparks a sharp distinction.

(*a*) Blurred streamers, which are often partly masked by the whole spark gap being filled with their light. These invariably correspond to lines prominent in the arc. (*b*) Sharply defined streamers, which appear throughout the whole time during which the electrical discharge lasts. These correspond to pure spark lines, *i.e.* lines which are not present in the arc under ordinary conditions. (*c*) A third class of streamers show very brightly at the first oscillation, but fade away so rapidly that they appear for only one or two oscillations, even when the other lines, initially no brighter, show ten or twelve. These lines are very sensitive to the influence of self-induction in the circuit; they are very bright in the condensed spark without inductance, but disappear from the spectrum altogether when a moderate inductance is inserted.

By studying the duration of the lines in the inductionless spark, the difference between the three classes of streamers is found to be solely a question of the duration of the luminosities of the metallic lines to which they correspond, the arc lines having a long, the spark lines a short, and the "condensed spark" lines a very short, duration.

(3) No other difference than this one of the durations of the lines has been discovered in the character of the streamers. The photographs obtained show clearly that the velocities of the streamers corresponding to the different lines in the same spark are the same, in spite of the different character of the streamers.

April 30.—"The Supersaturation and Nuclear Condensation of certain Organic Vapours." By T. H. **Laby**. Communicated by Prof. J. J. Thomson, F.R.S.

(1) The least expansion, which causes condensation in air initially saturated with an organic vapour and ionised by Röntgen rays, has been determined for five esters, six acids (formic to iso-valeric), and iso-amyl alcohol.

(2) In the case of acetic acid the expansion required was greater for feeble Röntgen rays than for more intense ones.

(3) The supersaturation, S, existing at the end of each of the expansions mentioned in (1) has been calculated, and also for four alcohols and chloroform from Przibram's experiments.

(4) The acids are found to have the largest values of S and the alcohols the least. The isomers examined have the same value for S with one exception. In the case of the alcohols, ethyl to iso-amyl, a fairly regular decrease in S accompanies the addition of a CH_2 group.